Matematiğin günlük hayattaki yeri için örnekler

Matematiksel İşlem/İçerik Örnek Yarar Alışveriş & Bütçe Toplama, çıkarma, yüzdeler %20 indirimli ürün, bütçe planı Harcamaları planlama ve tasarruf Mutfak Oran, çarpma, bölme 4 kişilik tarifi 6 kişiye göre düzenleme Ölçülü, doğru tarif hazırlama Ev Dekorasyon Alan hesaplama (en × boy) Odadaki duvarların boyanacağı alanı bulma Malzeme ve maliyet planı Seyahat & Ulaşım Mesafe, hız, zaman öngörüsü 100 km'de yakıt tüketimi hesabı Zamandan ve maliyetten tasarruf Spor & Sağlık Kalori hesabı Günlük/haftalık kalori hesabı Form koruma ve optimize aktivite Teknoloji & Bilim Veri analizi, grafik, lojik İnternet hız testi, robotik hesaplamalar Hızlı karar verme, düzenli takip 9. Sonuç ve Kısa Değerlendirme Günlük hayatta matematiğin kullanımı, yalnızca ders kitaplarında değil gerçek yaşamın her köşesinde karşımıza çıkar. Mantıklı bütçe planından, lezzetli yemek tarifleri oluşturmaya; en uygun seyahat rotasını belirlemeden, odanın kaç kutu boyaya ihtiyaç duyduğunu hesaplamaya kadar birçok örnek, matematiğin ne kadar gerekli olduğunu gösterir. Proje ödevinizde, seçtiğiniz bir veya birden fazla konuyu matematiksel verilere dayandırarak açıklamanız hem öğretici hem de keyifli bir süreç olacaktır. Verileri (örn. ölçümler, masraflar, grafikler) ne kadar somut ve anlaşılır sunarsanız, projenizin bilimselliği ve inandırıcılığı o kadar yüksek olacaktır. Bu projeyi tamamlarken sadece "formülleri uygulamak" değil, aynı zamanda matematiğin yaşamı nasıl kolaylaştırabileceğini fark etmek çok önemlidir. @Yasemin_Gencer Matematik ve Sayıların Günlük Hayattaki Kullanım Alanları ve Mühendislik Uygulamaları Matematik, insanlık tarihinin en eski bilim dallarından biri olarak kabul edilir. Farklı disiplinlerde ve günlük yaşamda geniş bir kullanım alanına sahip olan matematik, sayılar, yapılar, değişkenler ve ilişkileri inceleyen bir bilim dalıdır. Bu nedenle, matematik birçok alanda önemli bir rol oynamaktadır. Matematiği ne için kullanılır? Matematik, doğal fenomenleri anlamak, nicel verileri analiz etmek, problemleri çözmek, tahminlerde bulunmak ve genel olarak düşünme becerilerini geliştirmek için kullanılır. Ayrıca endüstride, ticarette, bilimde ve diğer birçok alanda matematiksel modellerin oluşturulması ve analiz edilmesi için kullanılır. Matematik hangi bilim dallarında kullanılır? Matematik, fizik, kimya, biyoloji, mühendislik, ekonomi, bilgisayar bilimleri ve daha birçok bilim dalında kullanılır. Örneğin, fiziktekinin kinematik denklemlerinin çözümlesinde, mühendislikte yapısal analizlerin yapılmasında ve biyolojide genetik modellerin oluşturulmasında matematik önemli bir role sahiptir. Günlük yaşamda matematik nerelerde kullanılır? Günlük yaşamda, matematik pek çok alanda kullanılır. Mesela, mutfakta yemek tariflerini hazırlarken doğru ölçümler yapmak, alışveriş yaparken indirim hesaplamaları yapmak, zamanı yönetmek için zaman hesaplamaları yapmak gibi birçok alanda matematiksel düşünce ve beceriler kullanılır. Ayrıca, yolculuk sırasında harita okuma, mesafe hesaplama gibi durumlarda da matematik devreye girer. Yazılımda matematik nerede kullanılır? Yazılım geliştirme sürecinde, matematik temel bir rol oynar. Algoritmaların tasarlanması, veri analizi, veri sıkıştırma, grafik işleme, yapay zeka ve oyun geliştirme gibi pek çok alanda matematiksel kavramlar ve formüller kullanılır. Örneğin, sayılar arası ilişkileri ifade etmek için matematiksel operasyonlar kullanılır. Rakam ve sayı nedir nerelerde kullanılır? Rakamlar ve sayılar, nicel değerleri ve miktarları ifade etmek için kullanılır. Günlük yaşamda para, saat, ölçüler, telefon numaraları gibi pek çok alanda rakamlar ve sayılar kullanılır. Ayrıca, bilimde, mühendislikte, matematikte ve istatistikte sayılar temel bir rol oynar. C dili hangi mühendislik alanlarında kullanılır? C dili, mühendislik alanlarında geniş bir kullanım alanına sahiptir. Özellikle elektrik, elektronik, bilgisayar, yazılım, havacılık ve otomotiv mühendisliği gibi alanlarda C dili sıkça kullanılır. Rakamlar nerede kullanılır? Rakamlar, pek çok alanda kullanılır. Mühendislikte, ticarette, finansta, bilimde, yapısal analizlerde, veri analizlerinde ve birçok matematiksel modelin oluşturulmasında ve çözümünde rakamların kullanımı yaygındır. C++ nerelerde kullanılır? C++, genellikle oyun geliştirme, büyük ölçekli yazılım geliştirme, bilgisayar grafikleri, finansal uygulamalar, gömülü sistemler ve performans odaklı uygulamalar gibi alanlarda sıklıkla kullanılır. C dili hangi mühendislik uygulamalarında kullanılır? C dili, gömülü sistemlerin tasarlanması, yazılım geliştirme, sürücü programlama, işletim sistemi geliştirme ve veri yapıları gibi birçok mühendislik uygulamasında kullanılır. C dili ne için kullanılır? C dili, genel amaçlı bir programlama dilidir ve sistem programlaması, yazılım geliştirme, gömülü sistemler gibi pek çok alanda kullanılır. Aynı zamanda C dili, performansı yüksek olan ve donanım ile doğrudan etkileşimde bulunan uygulamaların geliştirilmesi için tercih edilir. Kareli defter hangi dersler için kullanılır? Kareli defter, genellikle matematik, fen bilimleri, fizik, kimya ve geometri gibi derslerde not tutmak, denklemler çözmek, grafik çizimi yapmak gibi matematiksel ve bilimsel çalışmalar için kullanılır. Geçen seneki TYT puanı nasıl kullanılır 2023? Geçen seneki TYT puanı, 2023 yılında üniversite tercihi yapmak isteyen öğrenciler için kullanılır. TYT puanı, üniversite sınavında kullanılan bir puan türüdür ve öğrencilerin hangi üniversite ve hangi bölüme yerleşeceklerini belirlemede önemli bir faktördür. Bu puanlar, üniversite tercihi yapılırken dikkate alınır ve yerleştirme sürecinde kullanılır. Matematik ve sayılar, günlük yaşamdan mühendislik uygulamalarına, yazılım geliştirmeden akademik hayata kadar geniş bir kullanım alanına sahiptir. Bu nedenle, matematik ve sayılarla ilgili bilgi ve becerilere sahip olmak, birçok alanda başarıya ulaşmak için önemlidir. İçeriğe atla Son Güncelleme: Mayıs 1 2025Mayıs 15 2024 Yazar: TeknoDijital Çerezler (cookie),Web sitesini ve hizmetlerimizi daha etkin bir şekilde sunmamızı sağlamaktadır. Detaylı bilgi için Çerez Politikasını inceleyebilirsiniz. Para yönetimi. Market alışverişi. En uygun fiyatı bulmak. Yemek hazırlama. Yolculuk için mesafeyi, zamanı ve maliyeti hesaplamak. Arabalar, evler, eğitim veya diğer amaçlar için kredi kullanma. Sporun matematiksel mantığını anlamak. Müzik çalmak. Tarihte değiş tokuştan sonra ticaret yapma gereği duyulduğunda insanlar matematiği kullanmışlardır. Örnekleri arttırırsak; marketler, mağazacılar , hesaplamalarda , bankalarda, okuldaki derslerde, meteorolojide, elektrik ve elektronik işlerde, saat hesaplamalarında ve daha nice alanlarda matematik kullanılır. Matematik hayatımızı düzenli hale getirir ve kaosu önler. Matematik ile beslenen belli yetenekler; akıl yürütme gücü, yaratıcılık, soyut veya uzamsal düşünme, eleştirel düşünme, problem çözme yeteneği ve hatta etkili iletişim becerileridir. Matematik, uzun evrede problem çözme becerisi, kavrayabilme yeteneği, analitik düşünme ve öngörebilme özelliklerinin kazanımlarını sağlayacaktır. Matematik başlı başına zekâ gelişimiyle bağlantılı olan bir kavramdır. Matematik öğrenmek, insanın muhakeme ve mantık gücünü geliştirir. Daha da önemlisi problem çözme yetisini kazandırır. Problem çözmeyi matematik derslerindeki işçi veya hız problemlerini çözmek olarak algılamamak gerekir. Günlük hayatımızda mutlaka çözmemiz gereken durumlar ya da krizler olur. Medeniyetimizi ve yaşam konforumuzu borçlu olduğumuz matematik özellikle ülkemizde hak ettiği değeri pek göremiyor. Genelin uzak durduğu bu bilim dalı hayatın her alanındadır ve özellikle de problem çözme becerisini geliştirdiği için de çok önemlidir. Matematiğin tarihine baktığımızda Mayalar, Hintliler, Çinliler, Yunanlılar ve bazı İslam uygarlıklarının matematik alanına çalışmalar yaparak birbirleri ile bilgi alışverişinde bulunarak bu alanı geliştirip matematiği somut bir bilgi haline getirdikleri görülmüştür. Eğer matematik olmasaydı skor tutamazdık veya bir sahayı standart ölçülerde oluşturamazdık. Karşılaşmalar kaç dakika sürecek, topun atılış açısı, turnuvalar, gerisayım, eşitlik gibi kavramlar hayatımızda olmazdı. Belki gene spor yapıyor olurduk ama profesyonelliğe uzak ve sadece bireysel anlamda olabilirdi. "Matematik" terimini icat eden ve sadece matematik yapmak için matematik çalışmasını başlatan Pisagorculardı. Pisagor teoreminin ilk ispatı, teoremin uzun bir geçmişi olmasına ve irrasyonel sayıların varlığının kanıtı olmasına rağmen Pisagorculara atfedilir. Cebir ve geometri genellikle öğrencilerin en çok zorlandığı konular arasında yer alır. Cebir, özellikle de denklemler ve eşitsizlikler, öğrencilere karmaşık gelebilir çünkü bu konular genellikle bir problemin birden fazla çözüm yolunu gerektirir. Karşılaştırma yapma, sınıflama yapma, sıralama, ölçme, neden-sonuç ilişkisi kurma, ayrıntılara dikkat etme, tahminde bulunma, deney yapma, problem çözme yeteneklerini geliştirir. Yaratıcı düşünme ve akıl yürütme yeteneklerini geliştirir. Özel görünümü ve formülleriyle inşaat sektöründe de kullanılıyor. Günlük hayatta, koni örneklerini sıklıkla görebilirsiniz. Şapkalar, dondurma külahları, mutfak gereçleri, çatılar birer koniye örnektir. Koninin ne olduğunu ve özelliklerini öğrenirseniz işlemlerinizde rahatlıkla kullanabilirsiniz. Öğrencilere Matematik Neden Zor Gelir? Matematik öğrenimi, soyut kavramların anlaşılmasını, problem çözme yeteneklerini ve mantıksal düşünme becerisini gerektirir. Bu kavramlar, bazı öğrenciler için soyut olduğu ve öğrenme tarzlarıyla uyumlu olmadığı için zorlayıcı olabilir. Area of knowledge "Math" and "Maths" redirect here. For other uses, see Mathematics (disambiguation) and Math (disambiguation). Part of a series onMathematics History Index Areas Number theory Geometry Algebra Calculus and Analysis Discrete mathematics Logic Set theory Probability Statistics and Decision theory Relationship with sciences Physics Chemistry Geosciences Computation Biology Linguistics Economics Philosophy Education Mathematics Portalvte Mathematics is a field of study that discovers and organizes methods, theories and theorems that are developed and proved for the needs of empirical sciences and mathematics itself. There are many areas of mathematics, which include number theory (the study of numbers), algebra (the study of formulas and related structures), geometry (the study of shapes and spaces that contain them), analysis (the study of continuous changes), and set theory (presently used as a foundation for all mathematics). Mathematics involves the description and manipulation of abstract objects that consist of either abstractions from nature or—in modern mathematics—purely abstract entities that are stipulated to have certain properties, called axioms. Mathematics uses pure reason to prove properties of objects, a proof consisting of a succession of applications of deductive rules to already established results. These results include previously proved theorems, axioms, and—in case of abstraction from nature—some basic properties that are considered true starting points of the theory under consideration.[1] Mathematics is essential in the natural sciences, engineering, medicine, finance, computer science, and the social sciences. Although mathematics is extensively used for modeling phenomena, the fundamental truths of mathematics are independent of any scientific experimentation. Some areas of mathematics, such as statistics and game theory, are developed in close correlation with their applications and are often grouped under applied mathematics. Other areas are developed independently from any application (and are therefore called pure mathematics) but often later find practical applications.[2][3] Historically, the concept of a proof and its associated mathematical rigour first appeared in Greek mathematics, most notably in Euclid's Elements.[4] Since its beginning, mathematics was primarily divided into geometry and arithmetic (the manipulation of natural numbers and fractions), until the 16th and 17th centuries, when algebra[a] and infinitesimal calculus were introduced as new fields. Since then, the interaction between mathematical innovations and scientific discoveries has led to a correlated increase in the development of both.[5] At the end of the 19th century, the foundational crisis of mathematics led to the systematization of the axiomatic method,[6] which heralded a dramatic increase in the number of mathematical areas and their fields of application. The contemporary Mathematics Subject Classification lists more than sixty first-level areas of mathematics. Before the Renaissance, mathematics was divided into two main areas: arithmetic, regarding the manipulation of numbers, and geometry, regarding the study of shapes.[7] Some types of pseudoscience, such as numerology and astrology, were not then clearly distinguished from mathematics.[8] During the Renaissance, two more areas appeared. Mathematical notation led to algebra which, roughly speaking, consists of the study and the manipulation of formulas. Calculus, consisting of the two subfields differential calculus and integral calculus, is the study of continuous functions, which model the typically nonlinear relationships between varying quantities, as represented by variables. This division into four main areas—arithmetic, geometry, algebra, and calculus[9]—endured until the end of the 19th century. Areas such as celestial mechanics and solid mechanics were then studied by mathematicians, but now are considered as belonging to physics.[10] The subject of combinatorics has been studied for much of recorded history, yet did not become a separate branch of mathematics until the seventeenth century.[11] At the end of the 19th century, the foundational crisis in mathematics and the resulting systematization of the axiomatic method led to an explosion of new areas of mathematics.[12][6] The 2020 Mathematics Subject Classification contains no less than sixty-three first-level areas.[13] Some of these areas correspond to the older division, as is true regarding number theory (the modern name for higher arithmetic) and geometry. Several other first-level areas have "geometry" in their names or are otherwise commonly considered part of geometry. Algebra and calculus do not appear as first-level areas but are respectively split into several first-level areas. Other first-level areas emerged during the 20th century or had not previously been considered as mathematics, such as mathematical logic and foundations.[14] Main article: Number theory This is the Ulam spiral, which illustrates the distribution of prime numbers. The dark diagonal lines in the spiral hint at the hypothesized approximate independence between being prime and being a value of a quadratic polynomial, a conjecture now known as Hardy and Littlewood's Conjecture F. Number theory began with the manipulation of numbers, that is, natural numbers (N) , {\displaystyle (\mathbb {N}),} and later expanded to integers (Z) {\displaystyle (\mathbb {Z})} and rational numbers (Q) . {\displaystyle (\mathbb {Q}).} Number theory was once called arithmetic, but nowadays this term is mostly used for numerical calculations.[15] Number theory dates back to ancient Babylon and probably China. Two prominent early number theorists were Euclid of ancient Greece and Diophantus of Alexandria.[16] The modern study of number theory in its abstract form is largely attributed to Pierre de Fermat and Leonhard Euler. The field came to full fruition with the contributions of Adrien-Marie Legendre and Carl Friedrich Gauss.[17] Many easily stated number problems have solutions that require sophisticated methods, often from across mathematics. A prominent example is Fermat's Last Theorem. This conjecture was stated in 1637 by Pierre de Fermat, but it was proved only in 1994 by Andrew Wiles, who used tools including scheme theory from algebraic geometry, category theory, and homological algebra.[18] Another example is Goldbach's conjecture, which asserts that every even integer greater than 2 is the sum of two prime numbers. Stated in 1742 by Christian Goldbach, it remains unproven despite considerable effort.[19] Number theory includes several subareas, including analytic number theory, algebraic number theory, geometry of numbers (method oriented), diophantine equations, and transcendence theory (problem oriented).[14] Main article: Geometry On the surface of a sphere, Euclidean geometry only applies as a local approximation. For larger scales the sum of the angles of a triangle is not equal to 180°. Geometry is one of the oldest branches of mathematics. It started with empirical recipes concerning shapes, such as lines, angles and circles, which were developed mainly for the needs of surveying and architecture, but has since blossomed out into many other subfields.[20] A fundamental innovation was the ancient Greeks' introduction of the concept of proofs, which require that every assertion must be proved. For example, it is not sufficient to verify by measurement that, say, two lengths are equal; their equality must be proven via reasoning from previously accepted results (theorems) and a few basic statements. The basic statements are not subject to proof because they are self-evident (postulates), or are part of the definition of the subject of study (axioms). This principle, foundational for all mathematics, was first elaborated for geometry, and was systematized by Euclid around 300 BC in his book Elements. [21][22] The resulting Euclidean geometry is the study of shapes and their arrangements constructed from lines, planes and circles in the Euclidean plane (plane geometry) and the three-dimensional Euclidean space.[b][20] Euclidean geometry was developed without change of methods or scope until the 17th century, when René Descartes introduced what is now called Cartesian coordinates. This constituted a major change of paradigm: Instead of defining real numbers as lengths of line segments (see number line), it allowed the representation of points using their coordinates, which are numbers. Algebra (and later, calculus) can thus be used to solve geometrical problems. Geometry was split into two new subfields: synthetic geometry, which uses purely geometrical methods, and analytic geometry, which uses coordinates systemically.[23] Analytic geometry allows the study of curves unrelated to circles and lines. Such curves can be defined as the graph of functions, the study of which led to differential geometry. They can also be defined as implicit equations, often polynomial equations (which spawned algebraic geometry). Analytic geometry also makes it possible to consider Euclidean spaces of higher than three dimensions.[20] In the 19th century, mathematicians discovered non-Euclidean geometries, which do not follow the parallel postulate. By questioning that postulate's truth, this discovery has been viewed as joining Russell's paradox in revealing the foundational crisis of mathematics. This aspect of the crisis was solved by systematizing the axiomatic method, and adopting that the truth of the chosen axioms is not a mathematical problem.[24][6] In turn, the axiomatic method allows for the study of various geometries obtained either by changing the axioms or by considering properties that do not change under specific transformations of the space.[25] Today's subareas of geometry include:[14] Projective geometry, introduced in the 16th century by Girard Desargues, extends Euclidean geometry by adding points at infinity at which parallel lines intersect. This simplifies many aspects of classical geometry by unifying the treatments for intersecting and parallel lines. Affine geometry, the study of properties relative to parallelism and independent from the concept of length. Differential geometry, the study of curves, surfaces, and their generalizations, which are defined using differentiable functions. Manifold theory, the study of shapes that are not necessarily embedded in a larger space. Riemannian geometry, the study of distance properties in curved spaces. Algebraic geometry, the study of curves, surfaces, and their generalizations, which are defined using polynomials. Topology, the study of properties that are kept under continuous deformations. Algebraic topology, the use in topology of algebraic methods, mainly homological algebra. Discrete geometry, the study of finite configurations in geometry. Convex geometry, the study of convex sets, which takes its importance from its applications in optimization. Complex geometry, the geometry obtained by replacing real numbers with complex numbers. Main article: Algebra The quadratic formula, which concisely expresses the solutions of all quadratic equations The Rubik's Cube group is a concrete application of group theory.[26] Algebra is the art of manipulating equations and formulas. Diophantus (3rd century) and al-Khwarizmi (9th century) were the two main precursors of algebra.[27][28] Diophantus solved some equations involving unknown natural numbers by deducing new relations until he obtained the solution.[29] Al-Khwarizmi introduced systematic methods for transforming equations, such as moving a term from one side of an equation into the other side.[30] The term algebra is derived from the Arabic word al-jabr meaning 'the reunion of broken parts' that he used for naming one of these methods in the title of his main treatise.[31][32] Algebra became an area in its own right only with François Viète (1540–1603), who introduced the use of variables for representing unknown or unspecified numbers.[33] Variables allow mathematicians to describe the operations that have to be done on the numbers represented using mathematical formulas.[34] Until the 19th century, algebra consisted mainly of the study of linear equations (presently linear algebra), and polynomial equations in a single unknown, which were called algebraic equations (a term still in use, although it may be ambiguous). During the 19th century, mathematicians began to use variables to represent things other than numbers (such as matrices, modular integers, and geometric transformations), on which generalizations of arithmetic operations are often valid.[35] The concept of algebraic structure addresses this, consisting of a set whose elements are unspecified, of operations acting on the elements of the set, and rules that these operations must follow. The scope of algebra thus grew to include the study of algebraic structures. This object of algebra was called modern algebra or abstract algebra, as established by the influence and works of Emmy Noether,[36] and popularized by Van der Waerden's book Moderne Algebra. Some types of algebraic structures have useful and often fundamental properties, in many areas of mathematics. Their study became autonomous parts of algebra, and include:[14] group theory field theory vector spaces, whose study is essentially the same as linear algebra ring theory commutative algebra, which is the study of commutative rings, includes the study of polynomials, and is a foundational part of algebraic geometry homological algebra Lie algebra and Lie group theory Boolean algebra, which is widely used for the study of the logical structure of computers The study of types of algebraic structures as mathematical objects is the purpose of universal algebra and category theory.[37] The latter applies to every mathematical structure (not only algebraic ones). At its origin, it was introduced, together with homological algebra for allowing the algebraic study of non-algebraic objects such as topological spaces; this particular area of application is called algebraic topology.[38] Main articles: Calculus and Mathematical analysis A Cauchy sequence consists of elements such that all subsequent terms of a term become arbitrarily close to each other as the sequence progresses (from left to right). Calculus, formerly called infinitesimal calculus, was introduced independently and simultaneously by 17th-century mathematicians Newton and Leibniz.[39] It is fundamentally the study of the relationship of variables that depend on each other. Calculus was expanded in the 18th century by Euler with the introduction of the concept of a function and many other results.[40] Presently, "calculus" refers mainly to the elementary part of this theory, and "analysis" is commonly used for advanced parts.[41] Analysis is further subdivided into real analysis, where variables represent real numbers, and complex analysis, where variables represent complex numbers. Analysis includes many subareas shared by other areas of mathematics which include:[14] Multivariable calculus Functional analysis, where variables represent varying functions Integration, measure theory and potential theory, all strongly related with probability theory on a continuum Ordinary differential equations Partial differential equations Numerical analysis, mainly devoted to the computation on computers of solutions of ordinary and partial differential equations that arise in many applications Main article: Discrete mathematics A diagram representing a two-state Markov chain. The states are represented by 'A' and 'E'. The numbers are the probability of flipping the state. Discrete mathematics, broadly speaking, is the study of individual, countable mathematical objects. An example is the set of all integers.[42] Because the objects of study here are discrete, the methods of calculus and mathematical analysis do not directly apply.[c] Algorithms—especially their implementation and computational complexity—play a major role in discrete mathematics.[43] The four color theorem and optimal sphere packing were two major problems of discrete mathematics solved in the second half of the 20th century.[44] The P versus NP problem, which remains open to this day, is also important for discrete mathematics, since its solution would potentially impact a large number of computationally difficult problems.[45] Discrete mathematics includes:[14] Combinatorics, the art of enumerating mathematical objects that satisfy some given constraints. Originally, these objects were elements or subsets of a given set; this has been extended to various objects, which establishes a strong link between combinatorics and other parts of discrete mathematics. For example, discrete geometry includes counting configurations of geometric shapes. Graph theory and hypergraphs Coding theory, including error correcting codes and a part of cryptography Matroid theory Discrete geometry Discrete probability distributions Game theory (although continuous games are also studied, most common games, such as chess and poker are discrete) Discrete optimization, including combinatorial optimization, integer programming, constraint programming Main articles: Mathematical logic and Set theory The Venn diagram is a commonly used method to illustrate the relations between sets. The two subjects of mathematical logic and set theory have belonged to mathematics since the end of the 19th century.[46][47] Before this period, sets were not considered to be mathematical objects, and logic, although used for mathematical proofs, belonged to philosophy and was not specifically studied by mathematicians.[48] Before Cantor's study of infinite sets, mathematicians were reluctant to consider actually infinite collections, and considered infinity to be the result of endless enumeration. Cantor's work offended many mathematicians not only by considering actually infinite sets[49] but by showing that this implies different sizes of infinity, per Cantor's diagonal argument. This led to the controversy over Cantor's set theory.[50] In the same period, various areas of mathematics concluded the former intuitive definitions of the basic mathematical objects were insufficient for ensuring mathematical rigour. [51] This became the foundational crisis of mathematics.[52] It was eventually solved in mainstream mathematics by systematizing the axiomatic method inside a formalized set theory. Roughly speaking, each mathematical object is defined by the set of all similar objects and the properties that these objects must have.[12] For example, in Peano arithmetic, the natural numbers are defined by "zero is a number", "each number has a unique successor", "each number but zero has a unique predecessor", and some rules of reasoning.[53] This mathematical abstraction from reality is embodied in the modern philosophy of formalism, as founded by David Hilbert around 1910.[54] The "nature" of the objects defined this way is a philosophical problem that mathematicians leave to philosophers, even if many mathematicians have opinions on this nature, and use their opinion—sometimes called "intuition"—to guide their study and proofs. The approach allows considering "logics" (that is, sets of allowed deducing rules), theorems, proofs, etc. as mathematical objects, and to prove theorems about them. For example, Gödel's incompleteness theorems assert, roughly speaking that, in every consistent formal system that contains the natural numbers, there are theorems that are true (that is provable in a stronger system), but not provable inside the system.[55] This approach to the foundations of mathematics was challenged during the first half of the 20th century by mathematicians led by Brouwer, who promoted intuitionistic logic, which explicitly lacks the law of excluded middle.[56][57] These problems and debates led to a wide expansion of mathematical logic, with subareas such as model theory (modeling some logical theories inside other theories), proof theory, type theory, computability theory and computational complexity theory.[14] Although these aspects of mathematical logic were introduced before the rise of computers, their use in compiler design, formal verification, program analysis, proof assistants and other aspects of computer science, contributed in turn to the expansion of these logical theories.[58] Main articles: Statistics and Probability theory Whatever the form of a random population distribution (μ), the sampling mean (x̄) tends to a Gaussian distribution and its variance (σ) is given by the central limit theorem of probability theory.[59] The field of statistics is a mathematical application that is employed for the collection and processing of data samples, using procedures based on mathematical methods especially probability theory. Statisticians generate data with random sampling or randomized experiments.[60] Statistical theory studies decision problems such as minimizing the risk (expected loss) of a statistical action, such as using a procedure in, for example, parameter estimation, hypothesis testing, and selecting the best. In these traditional areas of mathematical statistics, a statistical-decision problem is formulated by minimizing an objective function, like expected loss or cost, under specific constraints. For example, designing a survey often involves minimizing the cost of estimating a population mean with a given level of confidence.[61] Because of its use of optimization, the mathematical theory of statistics overlaps with other decision sciences, such as operations research, control theory, and mathematical economics.[62] Main article: Computational mathematics Computational mathematics is the study of mathematical problems that are typically too large for human, numerical capacity.[63][64] Numerical analysis studies methods for problems in analysis using functional analysis and approximation theory; numerical analysis broadly includes the study of approximation and discretization with special focus on rounding errors.[65] Numerical analysis and, more broadly, scientific computing also study non-analytic topics of mathematical science, especially algorithmic-matrix-and-graph theory. Other areas of computational mathematics include computer algebra and symbolic computation. Main article: History of mathematics The word mathematics comes from the Ancient Greek word máthēma (μάθημα), meaning 'something learned, knowledge, mathematics', and the derived expression mathēmatikḗ tékhnē (μαθηματικὴ τέχνη), meaning 'mathematical science'. It entered the English language during the Late Middle English period through French and Latin.[66] Similarly, one of the two main schools of thought in Pythagoreanism was known as the mathēmatikoi (μαθηματικοί)—which at the time meant "learners" rather than "mathematicians" in the modern sense. The Pythagoreans were likely the first to constrain the use of the word to just the study of arithmetic and geometry. By the time of Aristotle (384–322 BC) this meaning was fully established.[67] In Latin and English, until around 1700, the term mathematics more commonly meant "astrology" (or sometimes "astronomy") rather than "mathematics"; the meaning gradually changed to its present one from about 1500 to 1800. This change has resulted in several mistranslations: For example, Saint Augustine's warning that Christians should beware of mathematici, meaning "astrologers", is sometimes mistranslated as a condemnation of mathematicians.[68] The apparent plural form in English goes back to the Latin neuter plural mathematica (Cicero), based on the Greek plural ta mathēmatiká (τὰ μαθηματικά) and means roughly "all things mathematical", although it is plausible that English borrowed only the adjective mathematic(al) and formed the noun mathematics anew, after the pattern of physics and metaphysics, inherited from Greek.[69] In English, the noun mathematics takes a singular verb. It is often shortened to maths[70] or, in North America, math.[71] The Babylonian mathematical tablet Plimpton 322, dated to 1800 BC In addition to recognizing how to count physical objects, prehistoric peoples may have also known how to count abstract quantities, like time—days, seasons, or years.[72][73] Evidence for more complex mathematics does not appear until around 3000 BC, when the Babylonians and Egyptians began using arithmetic, algebra, and geometry for taxation and other financial calculations, for building and construction, and for astronomy.[74] The oldest mathematical texts from Mesopotamia and Egypt are from 2000 to 1800 BC.[75] Many early texts mention Pythagorean triples and so, by inference, the Pythagorean theorem seems to be the most ancient and widespread mathematical concept after basic arithmetic and the definitions of the basic concepts of mathematics were not accurate enough for avoiding paradoxes (non-Euclidean geometries and Weierstrass function) and contradictions (Russell's paradox). This was solved by the inclusion of axioms with the apodictic inference rules of mathematical theories; the re-introduction of axiomatic method pioneered by the ancient Greeks.[6] It results that "rigor" is no more a relevant concept in mathematics, as a proof is either correct or erroneous, and a "rigorous proof" is simply a pleonasm. Where a special concept of rigor comes into play is in the socialized aspects of a proof, wherein it may be demonstrably refuted by other mathematicians. After a proof has been accepted for many years or even decades, it can then be considered as reliable.[179] Nevertheless, the concept of "rigor" may remain useful for teaching to beginners what is a mathematical proof.[180] Main article: Mathematics education Mathematics has a remarkable ability to cross cultural boundaries and time periods. As a human activity, the practice of mathematics has a social side, which includes education, careers, recognition, popularization, and so on. In education, mathematics is a core part of the curriculum and forms an important element of the STEM academic disciplines. Prominent careers for professional mathematicians include mathematics teacher or professor, statistician, actuary, financial analyst, economist, accountant, commodity trader, or computer consultant.[181] Archaeological evidence shows that instruction in mathematics occurred as early as the second millennium BCE in ancient Babylonia.[182] Comparable evidence has been unearthed for scribal mathematics training in the ancient Near East and then for the Greco-Roman world starting around 300 BCE.[183] The oldest known mathematics textbook is the Rhind papyrus, dated from c. 1650 BCE in Egypt.[184] Due to a scarcity of books, mathematical teachings in ancient India were communicated using memorized oral tradition since the Vedic period (c. 1500 – c. 500 BCE).[185] In Imperial China during the Tang dynasty (618–907 CE), a mathematics curriculum was adopted for the civil service exam to join the state bureaucracy.[186] Following the Dark Ages, mathematics education in Europe was provided by religious schools as part of the Quadrivium. Formal instruction in pedagogy began with Jesuit schools in the 16th and 17th century. Most mathematical curricula remained at a basic and practical level until the nineteenth century, when it began to flourish in France and Germany. The oldest journal addressing instruction in mathematics was L'Enseignement Mathématique, which began publication in 1899.[187] The Western advancements in science and technology led to the establishment of centralized education systems in many nation-states, with mathematics as a core component—initially for its military applications.[188] While the content of courses varies, in the present day nearly all countries teach mathematics to students for significant amounts of time.[189] During school, mathematical capabilities and positive expectations have a strong association with career interest in the field. Extrinsic factors such as feedback motivation by teachers, parents, and peer groups can influence the level of interest in mathematics.[190] Some students studying mathematics may develop an apprehension or fear about their performance in the subject. This is known as mathematical anxiety, and is considered the most prominent of the disorders impacting academic performance. Mathematical anxiety can develop due to various factors such as parental and teacher attitudes, social stereotypes, and personal traits. Help to counteract the anxiety can come from changes in instructional approaches, by interactions with parents and teachers, and by tailored treatments for the individual.[191] The validity of a mathematical theorem relies only on the rigor of its proof, which could theoretically be done automatically by a computer program. This does not mean that there is no place for creativity in a mathematical work. On the contrary, many important mathematical results (theorems) are solutions of problems that other mathematicians failed to solve, and the invention of a way for solving them may be a fundamental way of the solving process.[192][193] An extreme example is Apery's theorem: Roger Apery provided only the ideas for a proof, and the formal proof was given only several months later by three other mathematicians.[194] Creativity and rigor are not the only psychological aspects of the activity of mathematicians. Some mathematicians can see their activity as a game, more specifically as solving puzzles.[195] This aspect of mathematical activity is emphasized in recreational mathematics. Mathematicians can find an aesthetic value to mathematics. Like beauty, it is hard to define, it is commonly related to elegance, which involves qualities like simplicity, symmetry, completeness, and generality. G. H. Hardy in A Mathematician's Apology expressed the belief that the aesthetic considerations are, in themselves, sufficient to justify the study of pure mathematics. He also identified other criteria such as significance, unexpectedness, and inevitability, which contribute to mathematical aesthetics.[196] Paul Erdős expressed this sentiment more ironically by speaking of "The Book", a supposed divine collection of the most beautiful proofs. The 1998 book Proofs from THE BOOK, inspired by Erdős, is a collection of particularly succinct and revelatory mathematical arguments. Some examples of particularly elegant results included are Euclid's proof that there are infinitely many prime numbers and the fast Fourier transform for harmonic analysis.[197] Some feel that to consider mathematics a science is to downplay its artistry and history in the seven traditional liberal arts.[198] One way this difference of viewpoint plays out is in the philosophical debate as to whether mathematical results are created (as in art) or discovered (as in science).[131] The popularity of recreational mathematics is another sign of the pleasure many find in solving mathematical questions. Main article: Mathematics and art Notes that sound well together to a Western ear are sounds whose fundamental frequencies of vibration are in simple ratios. For example, an octave doubles the frequency and a perfect fifth multiplies it by 3 2 {\displaystyle {\frac {3}{2}}} .[199][200] Fractal with a scaling symmetry and a central symmetry Humans, as well as some other animals, find symmetric patterns to be more beautiful.[201] Mathematically, the symmetries of an object form a group known as the symmetry group.[202] For example, the group underlying mirror symmetry is the cyclic group of two elements, Z / 2 Z {\displaystyle \mathbb {Z} /2\mathbb {Z} } . A Rorschach test is a figure invariant by this symmetry,[203] as are butterfly and animal bodies more generally (at least on the surface).[204] Waves on the sea surface possess translation symmetry: moving one's viewpoint by the distance between wave crests does not change one's view of the sea.[205] Fractals possess self-similarity.[206][207] Main article: Popular mathematicsPopular mathematics is the act of presenting mathematics without technical terms.[208] Presenting mathematics may be hard since the general public suffers from mathematical anxiety and mathematical objects are highly abstract.[209] However, popular mathematics writing can overcome this by using applications or cultural links.[210] Despite this, mathematics is rarely the topic of popularization in printed or televised media. Main category: Mathematics awards The front side of the Fields Medal with an illustration of the Greek polymath Archimedes The most prestigious award in mathematics is the Fields Medal,[211][212] established in 1936 and awarded every four years (except around World War II) to up to four individuals.[213][214] It is considered the mathematical equivalent of the Nobel Prize.[214] Other prestigious mathematics awards include:[215] The Abel Prize, instituted in 2002[216] and first awarded in 2003[217] The Chern Medal for lifetime achievement, introduced in 2009[218] and first awarded in 2010[219] The AMS Leroy P. Steele Prize, awarded since 1970[220] The Wolf Prize in Mathematics, also for lifetime achievement,[221] instituted in 1978[222] A famous list of 23 open problems, called "Hilbert's problems", was compiled in 1900 by German mathematician David Hilbert.[223] This list has achieved great celebrity among mathematicians,[224] and at least thirteen of the problems (depending how some are interpreted) have been solved.[223] A new list of seven important problems, titled the "Millennium Prize Problems", was published in 2000. Only one of them, the Riemann hypothesis, duplicates one of Hilbert's problems. A solution to any of these problems carries a 1 million dollar reward.[225] To date, only one of these problems, the Poincaré conjecture, has been solved by the Russian mathematician Grigori Perelman.[226] Mathematics portal Law (mathematics) List of mathematical jargon Lists of mathematicians Lists of mathematics topics Mathematical constant Mathematical sciences Mathematics and art Mathematics education Philosophy of mathematics Relationship between mathematics and physics Science, technology, engineering, and mathematics ^ Here, algebra is taken in its modern sense, which is, roughly speaking, the art of manipulating formulas. ^ This includes conic sections, which are intersections of circular cylinders and planes. ^ However, some advanced methods of analysis are sometimes used; for example, methods of complex analysis applied to generating series. ^ For example, logic belongs to philosophy since Aristotle. Circa the end of the 19th century, the foundational crisis of mathematics implied developments of logic that are specific to mathematics. This allowed eventually the proof of theorems such as Gödel's theorems. Since then, mathematical logic is commonly considered as an area of mathematics. ^ This does not mean to make explicit all inference rules that are used. On the contrary, this is generally impossible, without computers and proof assistants. Even with this modern technology, it may take years of human work for writing down a completely detailed proof. ^ This does not mean that empirical evidence and intuition are not needed for choosing the theorems to be proved and to prove them. ^ This is the length of the original paper that does not contain the proofs of some previously published auxiliary results. The book devoted to the complete proof has more than 1,000 pages. ^ For considering as reliable a large computation occurring in a proof, one generally requires two computations using independent software ^ Hipólito, Inês Viegas (August 9–15, 2015). "Abstract Cognition and the Nature of Mathematical Proof". In Kanzian, Christian; Mitterer, Josef; Neges, Katharina (eds.). Realismus – Relativismus – Konstruktivismus: Beiträge des 38. Internationalen Wittgenstein Symposiums [Realism – Relativism – Constructivism: Contributions of the 38th International Wittgenstein Symposium] (PDF) (in German and English). Vol. 23. Kirchberg am Wechsel, Austria: Austrian Ludwig Wittgenstein Society. pp. 132–134. ISSN 1022-3398. OCLC 236026294. Archived (PDF) from the original on November 7, 2022. Retrieved January 17, 2024. (at ResearchGate Archived November 5, 2022, at the Wayback Machine) ^ Peterson 1988, p. 12. ^ a b Wigner, Eugene (1960). "The Unreasonable Effectiveness of Mathematics in the Natural Sciences". Communications on Pure and Applied Mathematics. 13 (1): 1–14. Bibcode:1960CPAM...13....1W. doi:10.1002/cpa.3160130102. S2CID 6112252. Archived from the original on February 28, 2011. ^ Wise, David. "Eudoxus' Influence on Euclid's Elements with a close look at The Method of Exhaustion". The University of Georgia. Archived from the original on June 1, 2019. Retrieved January 18, 2024. ^ Alexander, Amir (September 2011). "The Skeleton in the Closet: Should Historians of Science Care about the History of Mathematics?". Isis. 102 (3): 475–480. doi:10.1086/661620. ISSN 0021-1753. MR 2884913. PMID 22073771. S2CID 21629993. ^ a b c d e f Kleiner, Israel (December 1991). "Rigor and Proof in Mathematics: A Historical Perspective". Mathematics Magazine. 64 (5). Taylor & Francis, Ltd.: 291–314. doi:10.1080/0025570X.1991.11977625. eISSN 1930-0980. ISSN 0025-570X. JSTOR 2690647. LCCN 47003192. MR 1141557. OCLC 1756877. S2CID 7787171. ^ Bell, E. T. (1945) [1940]. "General Prospectus". The Development of Mathematics (2nd ed.). Dover Publications. p. 3. ISBN 978-0-486-27239-9. LCCN 45010599. OCLC 523284. ... mathematics has come down to the present by the two main streams of number and form. The first carried along arithmetic and algebra, the second, geometry. {{cite book}}: ISBN / Date incompatibility (help) ^ Tiwari, Sarju (1992). "A Mirror of Civilization". Mathematics in History, Culture, Philosophy, and Science (1st ed.). New Delhi, India: Mittal Publications. p. 27. ISBN 978-81-7099-404-6. LCCN 92909575. OCLC 28115124. It is unfortunate that two curses of mathematics--Numerology and Astrology were also born with it and have been more acceptable to the masses than mathematics itself. ^ Restivo, Sal (1992). "Mathematics from the Ground Up". In Bunge, Mario (ed.). Mathematics in Society and History. Episteme. Vol. 20. Kluwer Academic Publishers. p. 14. ISBN 0-7923-1765-3. LCCN 25709270. OCLC 92013695. ^ Musielak, Dora (2022). Leonhard Euler and the Foundations of Celestial Mechanics. History of Physics. Springer International Publishing. doi:10.1007/978-3-031-12322-1. eISSN 2730-7557. ISBN 978-3-031-12321-4. ISSN 2730-7549. OCLC 1332780664. S2CID 253240718. ^ Biggs, N. L. (May 1979). "The roots of combinatorics". Historia Mathematica. 6 (2): 109–136. doi:10.1016/0315-0860(79)90074-0. eISSN 1090-249X. ISSN 0315-0860. LCCN 75642280. OCLC 2240703. ^ a b Warner, Evan. "Splash Talk: The Foundational Crisis of Mathematics" (PDF). Columbia University. Archived from the original (PDF) on March 22, 2023. Retrieved February 3, 2024. ^ Dunne, Edward; Hulek, Klaus (March 2020). "Mathematics Subject Classification 2020" (PDF). Notices of the American Mathematical Society. 67 (3): 410–411. doi:10.1090/noti2052. eISSN 1088-9477. ISSN 0002-9920. LCCN sf77000404. OCLC 1480366. Archived (PDF) from the original on August 3, 2021. Retrieved February 3, 2024. The new MSC contains 63 two-digit classifications, 529 three-digit classifications, and 6,006 five-digit classifications. ^ a b c d e f g h "MSC2020-Mathematics Subject Classification System" (PDF). zbMath. Associate Editors of Mathematical Reviews and zbMATH. Archived (PDF) from the original on January 2, 2024. Retrieved February 3, 2024. ^ LeVeque, William J. (1977). "Introduction". Fundamentals of Number Theory. Addison-Wesley Publishing Company. pp. 1–30. ISBN 0-201-04287-8. LCCN 76055645. OCLC 3519779. S2CID 118560854. ^ Goldman, Jay R. (1998). "The Founding Fathers". The Queen of Mathematics: A Historically Motivated Guide to Number Theory. Wellesley, MA: A K Peters. pp. 2–3. doi:10.1201/9781439864623. ISBN 1-56881-006-7. LCCN 94020017. OCLC 30437959. S2CID 118934517. ^ Weil, André (1983). Number Theory: An Approach Through History From Hammurapi to Legendre. Birkhäuser Boston. pp. 2–3. doi:10.1007/978-0-8176-4571-7. ISBN 0-8176-3141-0. LCCN 83011857. OCLC 9576587. S2CID 117789303. ^ Kleiner, Israel (March 2000). "From Fermat to Wiles: Fermat's Last Theorem Becomes a Theorem". Elemente der Mathematik. 55 (1): 19–37. doi:10.1007/PL00000079. eISSN 1420-8962. ISSN 0013-6018. LCCN 66083524. OCLC 1567783. S2CID 53319514. ^ Wang, Yuan (2002). The Goldbach Conjecture. Series in Pure Mathematics. Vol. 4 (2nd ed.). World Scientific. pp. 1–18. doi:10.1142/5096. ISBN 981-238-159-7. LCCN 2003268597. OCLC 51533750. S2CID 14555830. ^ a b c Straume, Eldar (September 4, 2014). "A Survey of the Development of Geometry up to 1870". arXiv:1409.1140 [math.HO]. ^ Hilbert, David (1902). The Foundations of Geometry. Open Court Publishing Company. p. 1. doi:10.1126/science.16.399.307. LCCN 02019303. OCLC 996838. S2CID 238499430. Retrieved February 6, 2024. ^ Hartshorne, Robin (2000). "Euclid's Geometry". Geometry: Euclid and Beyond. Springer New York. pp. 9–13. ISBN 0-387-98650-2. LCCN 99044789. OCLC 42290188. Retrieved February 7, 2024. ^ Boyer, Carl B. (2004) [1956]. "Fermat and Descartes". History of Analytic Geometry. Dover Publications. pp. 74–102. ISBN 0-486-43832-5. LCCN 2004056235. OCLC 56317813. ^ Stump, David J. (1997). "Reconstructing the Unity of Mathematics circa 1900" (PDF). Perspectives on Science. 5 (3): 383–417. doi:10.1162/posc_a_00532. eISSN 1530-9274. ISSN 1063-6145. LCCN 94657506. OCLC 26085129. S2CID 117709681. Archived (PDF) from the original on February 8, 2024. Retrieved February 8, 2024. ^ O'Connor, J. J.; Robertson, E. F. (February 1996). "Non-Euclidean geometry". MacTuror. Scotland, UK: University of St. Andrews. Archived from the original on November 6, 2022. Retrieved February 8, 2024. ^ Joyner, David (2008). "The (legal) Rubik's Cube group". Adventures in Group Theory: Rubik's Cube, Merlin's Machine, and Other Mathematical Toys (2nd ed.). Johns Hopkins University Press. pp. 219–232. ISBN 978-0-8018-9012-3. LCCN 2008011322. OCLC 213765703. ^ Christianidis, Jean; Oaks, Jeffrey (May 2013). "Practicing algebra in late antiquity: The problem-solving of Diophantus of Alexandria". Historia Mathematica. 40 (2): 127–163. doi:10.1016/j.hm.2012.09.001. eISSN 1090-249X. ISSN 0315-0860. LCCN 75642280. OCLC 2240703. S2CID 121346342. ^ Kleiner 2007, "History of Classical Algebra" pp. 3–5. ^ Shane, David (2022). "Figurate Numbers: A Historical Survey of an Ancient Mathematics" (PDF). Methodist University. p. 20. Archived (PDF) from the original on June 5, 2024. Retrieved June 13, 2024. In his work, Diophantus focused on deducing the arithmetic properties of figurate numbers, such as deducing the number of sides, the different ways a number can be expressed as a figurate number, and the formulation of the arithmetic progressions. ^ Overbay, Shawn; Schorer, Jimmy; Conger, Heather. "Al-Khwarizmi". University of Kentucky. Archived from the original on June 29, 2024. Retrieved June 13, 2024. ^ Lim, Lisa (December 21, 2018). "Where the x we use in algebra came from, and the X in Xmas". South China Morning Post. Archived from the original on December 22, 2018. Retrieved February 8, 2024. ^ Berntjes, Sonja. "Algebra". Encyclopaedia of Islam Online (3rd ed.). ISSN 1573-3912. LCCN 2007238847. OCLC 56713464. Archived from the original on January 12, 2025. Retrieved June 13, 2024. ^ Oaks, Jeffery A. (2018). "François Viète's revolution in algebra" (PDF). Archive for History of Exact Sciences. 72 (3): 245–302. doi:10.1007/s00407-018-0208-0. eISSN 1432-0657. ISSN 0003-9519. LCCN 63024699. OCLC 1482042. S2CID 125704699. Archived (PDF) from the original on November 8, 2022. Retrieved February 8, 2024. ^ "Variable in Maths". GeeksforGeeks. April 24, 2024. Archived from the original on June 1, 2024. Retrieved June 13, 2024. ^ Kleiner 2007, "History of Linear Algebra" pp. 79–101. ^ Corry, Leo (2004). "Emmy Noether: Ideals and Structures". Modern Algebra and the Rise of Mathematical Structures (2nd revised ed.). Germany: Birkhäuser Basel. pp. 247–252. ISBN 3-7643-7002-5. LCCN 2004556211. OCLC 51234417. Retrieved February 8, 2024. ^ Riche, Jacques (2007). "From Universal Algebra to Universal Logic". In Beziau, J. Y.; Costa-Leite, Alexandre (eds.). Perspectives on Universal Logic. Milano, Italy: Polimetrica International Scientific Publisher. pp. 3–39. ISBN 978-88-7699-077-9. OCLC 647049731. Retrieved February 8, 2024. ^ Krömer, Ralph (2007). Tool and Object: A History and Philosophy of Category Theory. Science Networks – Historical Studies. Vol. 32. Germany: Springer Science & Business Media. pp. xxi–xxv, 1–91. ISBN 978-3-7643-7523-2. LCCN 2007920230. OCLC 85242858. Retrieved February 8, 2024. ^ Guicciardini, Niccolo (2017). "The Newton–Leibniz Calculus Controversy, 1708–1730" (PDF). In Schliesser, Eric; Smeenk, Chris (eds.). The Oxford Handbook of Newton. Oxford Handbooks. Oxford University Press. doi:10.1093/oxfordhb/9780199930418.013.9. ISBN 978-0-19-993041-8. OCLC 975829354. Archived (PDF) from the original on November 9, 2022. Retrieved February 9, 2024. ^ O'Connor, J. J.; Robertson, E. F. (September 1998). "Leonhard Euler". MacTutor. Scotland, UK: University of St Andrews. Archived from the original on November 9, 2022. Retrieved February 9, 2024. ^ "Calculus (Differential and Integral Calculus with Examples)". Byju's. Retrieved June 13, 2024. ^ Franklin, James (July 2017). "Discrete and Continuous: A Fundamental Dichotomy in Mathematics". Journal of Humanistic Mathematics. 7 (2): 355–378. doi:10.5642/jhummath.201702.18. ISSN 2159-8118. LCCN 2011202231. OCLC 700943261. S2CID 6945363. Archived from the original on March 10, 2024. Retrieved February 9, 2024. ^ Maurer, Stephen B. (1997). "What is Discrete Mathematics? The Many Answers". In Rosenstein, Joseph G.; Franzblau, Deborah S.; Roberts, Fred S. (eds.). Discrete Mathematics in the Schools. DIMACS: Series in Discrete Mathematics and Theoretical Computer Science. Vol. 36. American Mathematical Society. pp. 121–124. doi:10.1090/dimacs/036/13. ISBN 0-8218-0448-0. ISSN 1052-1798. LCCN 97023277. OCLC 37141146. S2CID 67358543. Retrieved February 9, 2024. ^ Hales, Thomas C. (2014). "Turing's Legacy: Developments from Turing's Ideas in Logic". In Downey, Rod (ed.). Turing's Legacy. Lecture Notes in Logic. Vol. 42. Cambridge University Press. pp. 260–261. doi:10.1017/CBO9781107338579.001. ISBN 978-1-107-04348-0. LCCN 2014000240. OCLC 867717052. S2CID 19315498. Retrieved February 9, 2024. ^ Sipser, Michael (July 1992). The History and Status of the P versus NP Question. STOC '92: Proceedings of the twenty-fourth annual ACM symposium on Theory of Computing. pp. 603–618. doi:10.1145/129712.129771. S2CID 11678884. ^ Ewald, William (November 17, 2018). "The Emergence of First-Order Logic". Stanford Encyclopedia of Philosophy. ISSN 1095-5054. LCCN sn97004494. OCLC 37550526. Retrieved June 14, 2024. ^ Ferreirós, José (June 18, 2020) [First published April 10, 2007]. "The Early Development of Set Theory". Stanford Encyclopedia of Philosophy. ISSN 1095-5054. LCCN sn97004494. OCLC 37550526. Archived from the original on May 12, 2021. Retrieved June 14, 2024. ^ Ferreirós, José (December 2001). "The Road to Modern Logic—An Interpretation" (PDF). The Bulletin of Symbolic Logic. 7 (4): 441–484. doi:10.2307/2687794. eISSN 1943-5894. hdl:11441/38373. ISSN 1079-8986. JSTOR 2687794. LCCN 95652899. OCLC 31616719. S2CID 43258676. Archived from the original (PDF) on February 2, 2023. Retrieved June 14, 2024. ^ Wolchover, Natalie, ed. (November 26, 2013). "Dispute over Infinity Divides Mathematicians". Quanta Magazine. Retrieved June 14, 2024. ^ Zhuang, Chaohui. "Wittgenstein's analysis on Cantor's diagonal argument" (DOC). PhilArchive. Retrieved June 14, 2024. ^ Tanswell, Fenner Stanley (2024). Mathematical Rigour and Informal Proof. Cambridge Elements in the Philosophy of Mathematics. Cambridge University Press. doi:10.1017/9781009325110. eISSN 2399-2883. ISBN 978-1-00-949438-0. ISSN 2514-3808. OCLC 1418750041. ^ Avigad, Jeremy; Reck, Erich H. (December 11, 2001). ""Clarifying the nature of the infinite": the development of metamathematics and proof theory" (PDF). Carnegie Mellon University. Archived (PDF) from the original on October 9, 2022. Retrieved June 14, 2024. ^ Hamilton, Alan G. (1982). Numbers, Sets and Axioms: The Apparatus of Mathematics. Cambridge University Press. pp. 3–4. ISBN 978-0-521-28761-6. Retrieved November 12, 2022. ^ Snapper, Ernst (September 1979). "The Three Crises in Mathematics: Logicism, Intuitionism, and Formalism". Mathematics Magazine. 52 (4): 207–216. doi:10.2307/2689412. ISSN 0025-570X. JSTOR 2689412. ^ a b Raatikainen, Panu (October 2005). "On the Philosophical Relevance of Gödel's Incompleteness Theorems". Revue Internationale de Philosophie. 59 (4): 513–534. doi:10.3917/rip.234.0513. JSTOR 23955909. S2CID 52083793. Archived from the original on November 12, 2022. Retrieved November 12, 2022. ^ Moschovakis, Joan (September 4, 2018). "Intuitionistic Logic". Stanford Encyclopedia of Philosophy. Archived from the original on December 16, 2022. Retrieved November 12, 2022. ^ McCarty, Charles (2006). "At the Heart of Analysis: Intuitionism and Philosophy". Philosophia Scientiæ, Cahier spécial 6: 81–94. doi:10.4000/philosophiascientiae.411. ^ Halpern, Joseph; Harper, Robert; Immerman, Neil; Kolaitis, Phokion; Vardi, Moshe; Vianu, Victor (2001). "On the Unusual Effectiveness of Logic in Computer Science" (PDF). Archived (PDF) from the original on March 3, 2021. Retrieved January 15, 2021. ^ Rouaud, Mathieu (April 2017) [First published July 2013]. Probability, Statistics and Estimation (PDF). p. 10. Archived (PDF) from the original on October 9, 2022. Retrieved February 13, 2024. ^ Rao, C. Radhakrishna (1997) [1989]. Statistics and Truth: Putting Chance to Work (2nd ed.). World Scientific. pp. 3–17, 63–70. ISBN 981-02-3111-3. LCCN 97010349. MR 1474730. OCLC 36597731. ^ Rao, C. Radhakrishna (1981). "Foreword". In Arthanari, T.S.; Dodge, Yadolah (eds.). Mathematical programming in statistics. Wiley Series in Probability and Mathematical Statistics. New York: Wiley. pp. vii–viii. ISBN 978-0-471-08073-2. LCCN 80021637. MR 0607328. OCLC 6707805. ^ Whittle 1994, pp. 10–11, 14–18. ^ Marchuk, Gurii Ivanovich (April 2020). "G I Marchuk's plenary: ICM 1970". MacTutor. School of Mathematics and Statistics, University of St Andrews, Scotland. Archived from the original on November 13, 2022. Retrieved November 13, 2022. ^ Johnson, Gary M.; Cavallini, John S. (September 1991). Phua, Kang Hoh; Loe, Kia Fock (eds.). Grand Challenges, High Performance Computing, and Computational Science. Singapore Supercomputing Conference'90: Supercomputing For Strategic Advantage. World Scientific. p. 28. LCCN 91018998. Retrieved November 13, 2022. ^ Trefethen, Lloyd N. (2008). "Numerical Analysis". In Gowers, Timothy; Barrow-Green, June; Leader, Imre (eds.). The Princeton Companion to Mathematics (PDF). Princeton University Press. pp. 604–615. ISBN 978-0-691-11880-2. LCCN 2008020450. MR 2467561. OCLC 227205932. Archived (PDF) from the original on March 7, 2023. Retrieved February 15, 2024. ^ Cresswell 2021, § MathematicsPerisho 1965, p. 64 ^ Perisho, Margaret W. (Spring 1965). "The Etymology of Mathematical Terms". Pi Mu Epsilon Journal. 4 (2): 62–66. ISSN 0031-952X. JSTOR 24338341. LCCN 58015848. OCLC 1762376. ^ Boas, Ralph P. (1995). "What Augustine Didn't Say About Mathematicians". In Alexanderson, Gerald L.; Mugler, Dale H. (eds.). Lion Hunting and Other Mathematical Pursuits: A Collection of Mathematics, Verse, and Stories. Mathematical Association of America. p. 257. ISBN 978-0-88385-323-8. LCCN 94078313. OCLC 633018890. ^ The Oxford Dictionary of English Etymology, Oxford English Dictionary, sub "mathematics", "mathematic", "mathematics". ^ "Maths (Noun)". Oxford English Dictionary. Oxford University Press. Archived from the original on January 25, 2024. Retrieved January 25, 2024. ^ "Math (Noun³)". Oxford English Dictionary. Oxford University Press. Archived from the original on April 4, 2020. Retrieved January 25, 2024. ^ See, for example, Wilder, Raymond L. Evolution of Mathematical Concepts; an Elementary Study. passim. ^ Zaslavsky, Claudia (1999). Africa Counts: Number and Pattern in African Culture. Chicago Review Press. ISBN 978-1-61374-115-3. OCLC 843204342. ^ Kline 1990, Chapter 1. ^ Mesopotamia pg 10. Retrieved June 1, 2024 ^ Boyer 1991, "Mesopotamia" pp. 24–27. ^ Heath, Thomas Little (1981) [1921]. A History of Greek Mathematics: From Thales to Euclid. New York: Dover Publications. p. 1. ISBN 978-0-486-24073-2. ^ Mueller, I. (1969). "Euclid's Elements and the Axiomatic Method". The British Journal for the Philosophy of Science. 20 (4): 289–309. doi:10.1093/bjps/20.4.289. ISSN 0007-0882. JSTOR 686258. ^ Boyer 1991, "Euclid of Alexandria" p. 119. ^ Boyer 1991, "Archimedes of Syracuse" p. 120. ^ Boyer 1991, "Archimedes of Syracuse" p. 130. ^ Boyer 1991, "Apollonius of Perga" p. 145. ^ Boyer 1991, "Greek Trigonometry and Mensuration" p. 162. ^ Boyer 1991, "Revival and Decline of Greek Mathematics" p. 180. ^ Ore, Øystein (1988). Number Theory and Its History. Courier Corporation. pp. 19–24. ISBN 978-0-486-65620-5. Retrieved November 14, 2022. ^ Singh, A. N. (January 1936). "On the Use of Series in Hindu Mathematics". Osiris. 1: 606–628. doi:10.1086/368443. JSTOR 301627. S2CID 144760421. ^ Kolachana, A.; Mahesh, K.; Ramasubramanian, K. (2019). "Use of series in India". Studies in Indian Mathematics and Astronomy. Sources and Studies in the History of Mathematics and Physical Sciences. Singapore: Springer. pp. 438–461. doi:10.1007/978-981-13-7326-8_20. ISBN 978-981-13-7325-1. S2CID 190176726. ^ Saliba, George (1994). A history of Arabic astronomy: planetary theories during the golden age of Islam. New York University Press. ISBN 978-0-8147-7962-0. OCLC 28723059. ^ Faruqi, Yasmeen M. (2006). "Contributions of Islamic scholars to the scientific enterprise". International Education Journal. 7 (4). Shannon Research Press: 391–399. Archived from the original on November 14, 2022. Retrieved November 14, 2022. ^ Lorch, Richard (June 2001). "Greek-Arabic-Latin: The Transmission of Mathematical Texts in the Middle Ages" (PDF). Science in Context. 14 (1–2). Cambridge University Press: 313–331. doi:10.1017/S0269889701000114. S2CID 146539132. Archived (PDF) from the original on December 17, 2022. Retrieved December 5, 2022. ^ Kent, Benjamin (2022). History of Science (PDF). Vol. 2. Bibliotex Digital Library. ISBN 978-1-984668-67-7. Archived (PDF) from the original on June 16, 2024. Retrieved June 16, 2024. ^ Archibald, Raymond Clare (January 1949). "History of Mathematics After the Sixteenth Century". The American Mathematical Monthly. Part 2: Outline of the History of Mathematics. 56 (1): 35–56. doi:10.2307/2304570. JSTOR 2304570. ^ Sevryuk 2006, pp. 101–109. ^ Wolfram, Stephan (October 2000). Mathematical Notation: Past and Future. MathML and Math on the Web: MathML International Conference 2000, Urbana Champaign, USA. Archived from the original on November 16, 2022. Retrieved February 3, 2024. ^ Douglas, Heather; Headley, Marcia Gail; Hadden, Stephanie; LeFevre, Jo-Anne (December 3, 2020). "Knowledge of Mathematical Symbols Goes Beyond Numbers". Journal of Numerical Cognition. 6 (3): 322–354. doi:10.5964/jnc.v6i3.293. eISSN 2363-8761. S2CID 228085700. ^ Letourneau, Mary; Wright Sharp, Jennifer (October 2017). "AMS Style Guide" (PDF). American Mathematical Society. p. 75. Archived (PDF) from the original on December 8, 2022. Retrieved February 3, 2024. ^ Jansen, Anthony R.; Marriott, Kim; Yelland, Greg W. (2000). "Constituent Structure in Mathematical Expressions" (PDF). Proceedings of the Annual Meeting of the Cognitive Science Society. 22. University of California Merced. eISSN 1069-7977. OCLC 68713073. Archived (PDF) from the original on November 16, 2022. Retrieved February 3, 2024. ^ Rossi, Richard J. (2006). Theorems, Corollaries, Lemmas, and Methods of Proof. Pure and Applied Mathematics: A Wiley Series of Texts, Monographs and Tracts. John Wiley & Sons. pp. 1–14, 47–48. ISBN 978-0-470-04295-3. LCCN 2006041609. OCLC 64085024. ^ "Earliest Uses of Some Words of Mathematics". MacTutor. Scotland, UK: University of St. Andrews. Archived from the original on September 29, 2022. Retrieved February 3, 2024. ^ Silver, Daniel S. (November–December 2017). "The New Language of Mathematics". The American Scientist. 105 (6). Sigma Xi: 364–371. doi:10.1511/2017.105.6.364. ISSN 0003-0996. LCCN 43020253. OCLC 1480717. S2CID 125455764. ^ Bellomo, Nicola; Preziosi, Luigi (December 22, 1994). Modelling Mathematical Methods and Scientific Computation. Mathematical Modeling. Vol. 1. CRC Press. p. 1. ISBN 978-0-8493-8331-1. Retrieved November 16, 2022. ^ Hennig, Christian (2010). "Mathematical Models and Reality: A Constructivist Perspective". Foundations of Science. 15: 29–48. doi:10.1007/s10699-009-9167-x. S2CID 6229200. Retrieved November 17, 2022. ^ Frigg, Roman; Hartmann, Stephan (February 4, 2020). "Models in Science". Stanford Encyclopedia of Philosophy. Archived from the original on November 17, 2022. Retrieved November 17, 2022. ^ Stewart, Ian (2018). "Mathematics, Maps, and Models". In Wuppuluri, Shyam; Doria, Francisco Antonio (eds.). The Map and the Territory: Exploring the Foundations of Science, Thought and Reality. The Frontiers Collection. Springer. pp. 345–356. doi:10.1007/978-3-319-72478-2_18. ISBN 978-3-319-72478-2. Retrieved November 17, 2022. ^ "The science checklist applied: Mathematics". Understanding Science. University of California, Berkeley. Archived from the original on October 27, 2019. Retrieved October 27, 2019. ^ Mackay, A. L. (1991). Dictionary of Scientific Quotations. London: Taylor & Francis. p. 100. ISBN 978-0-7503-0106-0. Retrieved March 19, 2023. ^ Bishop, Alan (1991). "Environmental activities and mathematical culture". Mathematical Enculturation: A Cultural Perspective on Mathematics Education. Norwell, Massachusetts: Kluwer Academic Publishers. pp. 20–59. ISBN 978-0-7923-1270-3. Retrieved April 5, 2020. ^ Shasha, Dennis Elliot; Lazere, Cathy A. (1998). Out of Their Minds: The Lives and Discoveries of 15 Great Computer Scientists. Springer. p. 228. ISBN 978-0-387-98269-4. ^ Nickles, Thomas (2013). "The Problem of Demarcation". Philosophy of Pseudoscience: Reconsidering the Demarcation Problem. Chicago: The University of Chicago Press. p. 104. ISBN 978-0-226-05182-6. ^ Pigliucci, Massimo (2014). "Are There 'Other' Ways of Knowing?". Philosophy Now. Archived from the original on May 13, 2020. Retrieved April 6, 2020. ^ a b Ferreirós, J. (2007). "Ὁ Θεὸς Ἀριθμητίζει: The Rise of Pure Mathematics as Arithmetic with Gauss". In Goldstein, Catherine; Schappacher, Norbert; Schwermer, Joachim (eds.). The Shaping of Arithmetic after C.F. Gauss's Disquisitiones Arithmeticae. Springer Science & Business Media. pp. 235–268. ISBN 978-3-540-34720-0. ^ Kuhn, Thomas S. (1976). "Mathematical vs. Experimental Traditions in the Development of Physical Science". The Journal of Interdisciplinary History. 7 (1). The MIT Press: 1–31. doi:10.2307/202372. JSTOR 202372. ^ Asper, Markus (2009). "The two cultures of mathematics in ancient Greece". In Robson, Eleanor; Stedall, Jacqueline (eds.). The Oxford Handbook of the History of Mathematics. Oxford Handbooks in Mathematics. OUP Oxford. pp. 107–132. ISBN 978-0-19-921312-2. Retrieved November 18, 2022. ^ Gozwami, Pinkimani; Singh, Madan Mohan (2019). "Integer Factorization Problem". In Ahmad, Khaleel; Doja, M. N.; Udzir, Nur Izura; Singh, Manu Pratap (eds.). Emerging Security Algorithms and Techniques. CRC Press. pp. 59–60. ISBN 978-0-8153-6145-9. LCCN 2019010556. OCLC 1082226900. ^ Maddy, P. (2008). "How applied mathematics became pure" (PDF). The Review of Symbolic Logic. 1 (1): 16–41. doi:10.1017/S1755020308080027. S2CID 18122406. Archived (PDF) from the original on August 12, 2017. Retrieved November 19, 2022. ^ Silver, Daniel S. (2017). "In Defense of Pure Mathematics". In Pitici, Mircea (ed.). The Best Writing on Mathematics, 2016. Princeton University Press. pp. 17–26. ISBN 978-0-691-17529-4. Retrieved November 19, 2022. ^ Parshall, Karen Hunger (2022). "The American Mathematical Society and Applied Mathematics from the 1920s to the 1950s: A Revisionist Account". Bulletin of the American Mathematical Society. 59 (3): 405–427. doi:10.1090/bull/1754. S2CID 249561106. Archived from the original on November 20, 2022. Retrieved November 20, 2022. ^ Stolz, Michael (2002). "The History Of Applied Mathematics And The History Of Society". Synthese. 133: 43–57. doi:10.1023/A:1020823608217. S2CID 34271623. Retrieved November 20, 2022. ^ Lin, C. C . (March 1976). "On the role of applied mathematics". Advances in Mathematics. 19 (3): 267–288. doi:10.1016/0001-8708(76)90024-4. ^ Peressini, Anthony (September 1999). Applying Pure Mathematics (PDF). Philosophy of Science. Proceedings of the 1998 Biennial Meetings of the Philosophy of Science Association. Part I: Contributed Papers. Vol. 66. pp. S1 – S13. JSTOR 188757. Archived (PDF) from the original on January 2, 2024. Retrieved November 30, 2022. ^ Lützen, J. (2011). "Examples and reflections on the interplay between mathematics and physics in the 19th and 20th century". In Schlote, K. H.; Schneider, M. (eds.). Mathematics meets physics: A contribution to their interaction in the 19th and the first half of the 20th century. Frankfurt am Main: Verlag Harri Deutsch. Archived from the original on March 23, 2023. Retrieved November 19, 2022. ^ Marker, Dave (July 1996). "Model theory and exponentiation". Notices of the American Mathematical Society. 43 (7): 753–759. Archived from the original on March 13, 2014. Retrieved November 19, 2022. ^ Chen, Changbo; Maza, Marc Moreno (August 2014). Cylindrical Algebraic Decomposition in the RegularChains Library. International Congress on Mathematical Software 2014. Lecture Notes in Computer Science. Vol. 8592. Berlin: Springer. doi:10.1007/978-3-662-44199-2_65. Retrieved November 19, 2022. ^ Pérez-Escobar, José Antonio; Sarikaya, Deniz (2021). "Purifying applied mathematics and applying pure mathematics: how a late Wittgensteinian perspective sheds light onto the dichotomy". European Journal for Philosophy of Science. 12 (1): 1–22. doi:10.1007/s13194-021-00435-9. S2CID 245465895. ^ Takase, M. (2014). "Pure Mathematics and Applied Mathematics are Inseparably Intertwined: Observation of the Early Analysis of the Infinity". A Mathematical Approach to Research Problems of Science and Technology. Mathematics for Industry. Vol. 5. Tokyo: Springer. pp. 393–399. doi:10.1007/978-4-431-55060-0_29. ISBN 978-4-431-55059-4. Retrieved November 20, 2022. ^ Sarukkai, Sundar (February 10, 2005). "Revisiting the 'unreasonable effectiveness' of mathematics". Current Science. 88 (3): 415–423. JSTOR 24110208. ^ Wagstaff, Samuel S. Jr. (2021). "History of Integer Factoring" (PDF). In Bos, Joppe W.; Stam, Martijn (eds.). Computational Cryptography, Algorithmic Aspects of Cryptography, A Tribute to AKL. London Mathematical Society Lecture Notes Series 469. Cambridge University Press. pp. 41–77. Archived (PDF) from the original on November 20, 2022. Retrieved November 20, 2022. ^ "Curves: Ellipse". MacTutor. School of Mathematics and Statistics, University of St Andrews, Scotland. Archived from the original on October 14, 2022. Retrieved November 20, 2022. ^ Mukunth, Vasudevan (September 10, 2015). "Beyond the Surface of Einstein's Relativity Lay a Chimerical Geometry". The Wire. Archived from the original on November 20, 2022. Retrieved November 20, 2022. ^ Wilson, Edwin B.; Lewis, Gilbert N. (November 1912). "The Space-Time Manifold of Relativity. The Non-Euclidean Geometry of Mechanics and Electromagnetics". Proceedings of the American Academy of Arts and Sciences. 48 (11): 389–507. doi:10.2307/20022840. JSTOR 20022840. ^ a b c Borel, Armand (1983). "Mathematics: Art and Science". The Mathematical Intelligencer. 5 (4). Springer: 9–17. doi:10.4171/news/103/8. ISSN 1027-488X. ^ Hanson, Norwood Russell (November 1961). "Discovering the Positron (I)". The British Journal for the Philosophy of Science. 12 (47). The University of Chicago Press: 194–214. doi:10.1093/bjps/xiii.49.54. JSTOR 685207. ^ Ginammi, Michele (February 2016). "Avoiding reification: Heuristic effectiveness of mathematics and the prediction of the Ω– particle". Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics. 53: 20–27. Bibcode:2016SHPMP..53...20G. doi:10.1016/j.shpsb.2015.12.001. ^ Wagh, Sanjay Moreshwar; Deshpande, Dilip Abasaheb (September 27, 2012). Essentials of Physics. PHI Learning Pvt. Ltd. p. 3. ISBN 978-81-203-4642-0. Retrieved January 3, 2023. ^ Atiyah, Michael (1990). On the Work of Edward Witten (PDF). Proceedings of the International Congress of Mathematicians. p. 31. Archived from the original (PDF) on September 28, 2013. Retrieved December 29, 2022. ^ "Course 18C Mathematics with Computer Science". math.mit.edu. Retrieved June 1, 2024. ^ "Theoretical Computer Science". math.mit.edu. Retrieved June 1, 2024. ^ "Real-Life Applications of Discrete Mathematics". GeeksforGeeks. April 8, 2024. Archived from the original on May 19, 2024. Retrieved May 19, 2024. ^ Hales, Thomas; Adams, Mark; Bauer, Gertrud; Dang, Tat Dat; Harrison, John; Hoang, Le Truong; Kaliszyk, Cezary; Magron, Victor; Mclaughlin, Sean; Nguyen, Tat Thang; Nguyen, Quang Truong; Nipkow, Tobias; Obua, Steven; Pleso, Joseph; Rute, Jason; Solovyev, Alexey; Ta, Thi Hoai An; Tran, Nam Trung; Trieu, Thi Diep; Urban, Josef; Vu, Ky; Zumkeller, Roland (2017). "A Formal Proof of the Kepler Conjecture". Forum of Mathematics, Pi. 5: e2. doi:10.1017/fmp.2017.1. hdl:2066/176365. ISSN 2050-5086. S2CID 216912822. Archived from the original on December 4, 2020. Retrieved February 25, 2023. ^ a b c Millstein, Roberta (September 8, 2016). "Probability in Biology: The Case of Fitness" (PDF). In Hájek, Alan; Hitchcock, Christopher (eds.). The Oxford Handbook of Probability and Philosophy. pp. 601–622. doi:10.1093/oxfordhb/9780199607617.013.27. Archived (PDF) from the original on March 7, 2023. Retrieved December 29, 2022. ^ See for example Anne Laurent, Roland Gamet, Jérôme Pantel, Tendances nouvelles en modélisation pour l'environnement, actes du congrès «Programme environnement, vie et sociétés» 15–17 janvier 1996, CNRS ^ Bouleau 1999, pp. 282–283. ^ Bouleau 1999, p. 285. ^ "1.4: The Lotka-Volterra Predator-Prey Model". Mathematics LibreTexts. January 5, 2022. Archived from the original on December 29, 2022. Retrieved December 29, 2022. ^ Salsburg, David (August 17, 1992). "Commentary" (PDF). The Use of Statistical Methods in the Analysis of Clinical Studies. 46: 17. Archived (PDF) from the original on June 1, 2024. Retrieved June 1, 2024. ^ National Research Council (2003). "8". Beyond the Molecular Frontier: Challenges for Chemistry and Chemical Engineering. NAP.edu. pp. 71–73. doi:10.17226/10633. ISBN 978-0-309-16839-7. PMID 25032300. ^ "Catastrophe Models (Property)". content.naic.org. Archived from the original on May 19, 2024. Retrieved May 19, 2024. ^ "MAM2001 Essay". ww2.amstat.org. Archived from the original on May 19, 2024. Retrieved May 19, 2024. ^ Hill, Mullica (September 7, 2022). "HOW MATH IS USED IN WEATHER FORECASTING". mathnasium.com. Archived from the original on May 19, 2024. Retrieved May 19, 2024. ^ "Using Mathematical Models to Investigate Planetary Habitability" (PDF). NASA. Archived (PDF) from the original on May 19, 2024. Retrieved May 19, 2024. ^ Edling, Christofer R. (2002). "Mathematics in Sociology". Annual Review of Sociology. 28 (1): 197–220. doi:10.1146/annurev.soc.28.110601.140942. ISSN 0360-0572. Archived from the original on November 15, 2021. Retrieved September 30, 2023. ^ Batchelder, William H. (January 1, 2015). "Mathematical Psychology: History". In Wright, James D. (ed.). International Encyclopedia of the Social & Behavioral Sciences (Second Edition). Oxford: Elsevier. pp. 808–815. ISBN 978-0-08-097087-5. Archived from the original on February 17, 2023. Retrieved September 30, 2023. ^ a b Zak, Paul J. (2010). Moral Markets: The Critical Role of Values in the Economy. Princeton University Press. p. 158. ISBN 978-1-4008-3736-6. Retrieved January 3, 2023. ^ Levin, Jonathan; Milgrom, Paul (September 2004). Introduction to Choice Theory (PDF). ^ Kremer, Michael; Rao, Gautam; Schilbach, Frank (2019). "Chapter 5 Behavioral development economics". Handbook of Behavioral Economics: Applications and Foundations (PDF). Vol. 2. Archived (PDF) from the original on June 2, 2024. Retrieved June 2, 2024. ^ "Mathematics". mdpi.com. ^ "Kondratiev, Nikolai Dmitrievich | Encyclopedia.com". www.encyclopedia.com. Archived from the original on July 1, 2016. Retrieved December 29, 2022. ^ "Mathématique de l'histoire-géometrie et cinématique. Lois de Brück. Chronologie géodésique de la Bible., by Charles LAGRANGE et al. | The Online Books Page". onlinebooks.library.upenn.edu. Archived from the original on January 3, 2024. Retrieved January 3, 2024. ^ "Cliodynamics: a science for predicting the future". ZDNet. Archived from the original on December 29, 2022. Retrieved December 29, 2022. ^ Sokal, Alan; Jean Bricmont (1998). Fashionable Nonsense. New York: Picador. ISBN 978-0-312-19545-8. OCLC 39605994. ^ "Biden's Misleading Unemployment Statistic – FactCheck.org". January 27, 2023. Archived from the original on June 2, 2024. Retrieved June 2, 2024. ^ "Modern Macroeconomic Models as Tools for Economic Policy | Federal Reserve Bank of Minneapolis". minneapolisfed.org. Archived from the original on August 3, 2024. Retrieved June 2, 2024. ^ Balaguer, Mark (2016). "Platonism in Metaphysics". In Zalta, Edward N. (ed.). The Stanford Encyclopedia of Philosophy (Spring 2016 ed.). Metaphysics Research Lab, Stanford University. Archived from the original on January 30, 2022. Retrieved April 2, 2022. ^ See White, L. (1947). "The locus of mathematical reality: An anthropological footnote". Philosophy of Science. 14 (4): 289–303. doi:10.1086/286957. S2CID 119887253. 189303; also in Newman, J. R. (1956). The World of Mathematics. Vol. 4. New York: Simon and Schuster. pp. 2348–2364. ^ Dorato, Mauro (2005). "Why are laws mathematical?" (PDF). The Software of the Universe, An Introduction to the History and Philosophy of Laws of Nature. Ashgate. pp. 31–66. ISBN 978-0-7546-3994-7. Archived (PDF) from the original on August 17, 2023. Retrieved December 5, 2022. ^ Mura, Roberta (December 1993). "Images of Mathematics Held by University Teachers of Mathematical Sciences". Educational Studies in Mathematics. 25 (4): 375–85. doi:10.1007/BF01273907. JSTOR 3482762. S2CID 122351146. ^ Tobies, Renate; Neunzert, Helmut (2012). Iris Runge: A Life at the Crossroads of Mathematics, Science, and Industry. Springer. p. 9. ISBN 978-3-0348-0229-1. Retrieved June 20, 2015. [I]t is first necessary to ask what is meant by mathematics in general. Illustrious scholars have debated this matter until they were blue in the face, and yet no consensus has been reached about whether mathematics is a natural science, a branch of the humanities, or an art form. ^ Ziegler, Günter M.; Loos, Andreas (November 2, 2017). Kaiser, G. (ed.). "What is Mathematics?" and why we should ask, where one should experience and learn that, and how to teach it. Proceedings of the 13th International Congress on Mathematical Education. ICME-13 Monographs. Springer. pp. 63–77. doi:10.1007/978-3-319-62597-3_5. ISBN 978-3-319-62596-6. (Sections "What is Mathematics?" and "What is Mathematics, Really?") ^ Mura 1993, pp. 379, 381. ^ Brown & Porter 1995, p. 326. ^ Strauss, Danie (2011). "Defining mathematics". Acta Academica. 43 (4): 1–28. Retrieved November 25, 2022. ^ Franklin, James (2009). Philosophy of Mathematics. Elsevier. pp. 104–106. ISBN 978-0-08-093058-9. Retrieved June 20, 2015. ^ Cajori, Florian (1893). A History of Mathematics. American Mathematical Society (1991 reprint). pp. 285–286. ISBN 978-0-8218-2102-2. Retrieved June 20, 2015. {{cite book}}: ISBN / Date incompatibility (help) ^ Devlin 2018, p. 3. ^ Saunders Maclane (1986). Mathematics, form and function. Springer., page 409 ^ Brown, Ronald; Porter, Timothy (1995). "The Methodology of Mathematics". The Mathematical Gazette. 79 (485): 321–334. doi:10.2307/3618304. JSTOR 3618304. S2CID 178923299. Archived from the original on March 23, 2023. Retrieved November 25, 2022. ^ Hamami, Yacin (June 2022). "Mathematical Rigor and Proof" (PDF). The Review of Symbolic Logic. 15 (2): 409–449. doi:10.1017/S1755020319000443. S2CID 209980693. Archived (PDF) from the original on December 5, 2022. Retrieved November 21, 2022. ^ Peterson 1988, p. 4: "A few complain that the computer program can't be verified properly." (in reference to the Haken–Appel proof of the Four Color Theorem) ^ Perminov, V. Ya. (1988). "On the Reliability of Mathematical Proofs". Philosophy of Mathematics. 42 (167 (4)). Revue Internationale de Philosophie: 500–508. ^ Davis, Jon D.; McDuffie, Amy Roth; Drake, Corey; Seiwell, Amanda L. (2019). "Teachers' perceptions of the official curriculum: Problem solving and rigor". International Journal of Educational Research. 93: 91–100. doi:10.1016/j.ijer.2018.10.002. S2CID 149753721. ^ Endsley, Kezia (2021). Mathematicians and Statisticians: A Practical Career Guide. Practical Career Guides. Rowman & Littlefield. pp. 1–3. ISBN 978-1-5381-4517-3. Retrieved November 29, 2022. ^ Robson, Eleanor (2009). "Mathematics education in an Old Babylonian scribal school". In Robson, Eleanor; Stedall, Jacqueline (eds.). The Oxford Handbook of the History of Mathematics. OUP Oxford. ISBN 978-0-19-921312-2. Retrieved November 24, 2022. ^ Bernard, Alain; Proust, Christine; Ross, Micah (2014). "Mathematics Education in Antiquity". In Karp, A.; Schubring, G. (eds.). Handbook on the History of Mathematics Education. New York: Springer. pp. 27–53. doi:10.1007/978-1-4614-9155-2_3. ISBN 978-1-4614-9154-5. ^ Dudley, Underwood (April 2002). "The World's First Mathematics Textbook". Math Horizons. 9 (4). Taylor & Francis, Ltd.: 8–11. doi:10.1080/10724117.2002.11975154. JSTOR 25678363. S2CID 126067145. ^ Subramarian, F. Indian pedagogy and problem solving in ancient Thamizhakam (PDF). History and Pedagogy of Mathematics conference, July 16–20, 2012. Archived (PDF) from the original on November 28, 2022. Retrieved November 29, 2022. ^ Siu, Man Keung (2004). "Official Curriculum in Mathematics in Ancient China: How did Candidates Study for the Examination?". How Chinese Learn Mathematics (PDF). Series on Mathematics Education. Vol. 1. pp. 157–185. doi:10.1142/9789812562241_0006. ISBN 978-981-256-014-8. Retrieved November 26, 2022. ^ Jones, Phillip S. (1967). "The History of Mathematical Education". The American Mathematical Monthly. 74 (1). Taylor & Francis, Ltd.: 38–55. doi:10.2307/2314867. JSTOR 2314867. ^ Schubring, Gert; Furinghetti, Fulvia; Siu, Man Keung (August 2012). "Introduction: the history of mathematics teaching. Indicators for modernization processes in societies". ZDM Mathematics Education. 44 (4): 457–459. doi:10.1007/s11858-012-0445-7. S2CID 145507519. ^ von Davier, Matthias; Foy, Pierre; Martin, Michael O.; Mullis, Ina V.S. (2020). "Examining eTIMSS Country Differences Between eTIMSS Data and Bridge Data: A Look at Country-Level Mode of Administration Effects". TIMSS 2019 International Results in Mathematics and Science (PDF). TIMSS & PIRLS International Study Center, Lynch School of Education and Human Development and International Association for the Evaluation of Educational Achievement. p. 13.1. ISBN 978-1-889938-54-7. Archived (PDF) from the original on November 29, 2022. Retrieved November 29, 2022. ^ Rowan-Kenyon, Heather T.; Swan, Amy K.; Creager, Marie F. (March 2012). "Social Cognitive Factors, Support, and Engagement: Early Adolescents' Math Interests as Precursors to Choice of Career" (PDF). The Career Development Quarterly. 60 (1): 2–15. doi:10.1002/j.2161-0045.2012.00001.x. Archived (PDF) from the original on November 22, 2023. Retrieved November 29, 2022. ^ Luttenberger, Silke; Wimmer, Sigrid; Paechter, Manuela (2018). "Spotlight on math anxiety". Psychology Research and Behavior Management. 11: 311–322. doi:10.2147/PRBM.S141421. PMC 6087017. PMID 30123014. ^ Yaftian, Narges (June 2, 2015). "The Outlook of the Mathematicians' Creative Processes". Procedia – Social and Behavioral Sciences. 191: 2519–2525. doi:10.1016/j.sbspro.2015.04.617. ^ Nadjafikhah, Mehdi; Yaftian, Narges (October 10, 2013). "The Frontage of Creativity and Mathematical Creativity". Procedia – Social and Behavioral Sciences. 90: 344–350. doi:10.1016/j.sbspro.2013.07.101. ^ van der Poorten, A. (1979). "A proof that Euler missed... Apéry's Proof of the irrationality of ζ(3)" (PDF). The Mathematical Intelligencer. 1 (4): 195–203. doi:10.1007/BF03028234. S2CID 121589323. Archived (PDF) from the original on September 6, 2015. Retrieved November 22, 2022. ^ Petkovi, Miodrag (September 2, 2009). Famous Puzzles of Great Mathematicians. American Mathematical Society. pp. xiii–xiv. ISBN 978-0-8218-4814-2. Retrieved November 25, 2022. ^ Hardy, G. H. (1940). A Mathematician's Apology. Cambridge University Press. ISBN 978-0-521-42706-7. Retrieved November 22, 2022. {{cite book}}: ISBN / Date incompatibility (help) See also A Mathematician's Apology. ^ Alon, Noga; Goldston, Dan; Sárközy, András; Szabados, József; Tenenbaum, Gérald; Garcia, Stephan Ramon; Shoemaker, Amy L. (March 2015). Alladi, Krishnaswami; Krantz, Steven G. (eds.). "Reflections on Paul Erdős on His Birth Centenary, Part II". Notices of the American Mathematical Society. 62 (3): 226–247. doi:10.1090/noti1223. ^ See, for example Bertrand Russell's statement "Mathematics, rightly viewed, possesses not only truth, but supreme beauty ..." in his History of Western Philosophy. 1919. p. 60. ^ Cazden, Norman (October 1959). "Musical intervals and simple number ratios". Journal of Research in Music Education. 7 (2): 197–220. doi:10.1177/002242945900700205. JSTOR 3344215. S2CID 220636812. ^ Budden, F. J. (October 1967). "Modern mathematics and music". The Mathematical Gazette. 51 (377). Cambridge University Press ({{CUP}}): 204–215. doi:10.2307/3613237. JSTOR 3613237. S2CID 126119711. ^ Enquist, Magnus; Arak, Anthony (November 1994). "Symmetry, beauty and evolution". Nature. 372 (6502): 169–172. Bibcode:1994Natur.372..169E. doi:10.1038/372169a0. ISSN 1476-4687. PMID 7969448. S2CID 4310147. Archived from the original on December 28, 2022. Retrieved December 29, 2022. ^ Hestenes, David (1999). "Symmetry Groups" (PDF). ^ Bender, Sara (September 2020). "The Rorschach Test". In Carducci, Bernardo J.; Nave, Christopher S.; Mio, Jeffrey S.; Riggio, Ronald E. (eds.). The Wiley Encyclopedia of Personality and Individual Differences: Measurement and Assessment. Wiley. pp. 367–376. doi:10.1002/9781119547167.ch131. ISBN 978-1-119-05751-2. ^ Weyl, Hermann (2015). Symmetry. Princeton Science Library. Vol. 47. Princeton University Press. p. 4. ISBN 978-1-4008-7434-7. ^ "Lecture 8: Translation Symmetry | Physics III: Vibrations and Waves | Physics". MIT OpenCourseWare. ^ Bradley, Larry (2010). "Fractals – Chaos & Fractals". stsci.edu. Archived from the original on March 7, 2023. Retrieved December 29, 2022. ^ "Self-similarity". math.bu.edu. Archived from the original on March 2, 2023. Retrieved December 29, 2022. ^ Kissane, Barry (July 2009). Popular mathematics. 22nd Biennial Conference of The Australian Association of Mathematics Teachers. Fremantle, Western Australia: Australian Association of Mathematics Teachers. pp. 125–126. Archived from the original on March 7, 2023. Retrieved December 29, 2022. ^ Steen, L. A. (2012). Mathematics Today Twelve Informal Essays. Springer Science & Business Media. p. 2. ISBN 978-1-4613-9435-8. Retrieved January 3, 2023. ^ Pitici, Mircea (2017). The Best Writing on Mathematics 2016. Princeton University Press. ISBN 978-1-4008-8560-2. Retrieved January 3, 2023. ^ Monastyrsky 2001, p. 1: "The Fields Medal is now indisputably the best known and most influential award in mathematics." ^ Riehm 2002, pp. 778–782. ^ "Fields Medal | International Mathematical Union (IMU)". www.mathunion.org. Archived from the original on December 26, 2018. Retrieved February 21, 2022. ^ a b "Fields Medal". Maths History. Archived from the original on March 22, 2019. Retrieved February 21, 2022. ^ "Honours/Prizes Index". MacTutor History of Mathematics Archive. Archived from the original on December 17, 2021. Retrieved February 20, 2023. ^ "About the Abel Prize". The Abel Prize. Archived from the original on April 14, 2022. Retrieved January 23, 2022. ^ "Abel Prize | mathematics award". Encyclopedia Britannica. Archived from the original on January 26, 2020. Retrieved January 23, 2022. ^ "Chern Medal Award" (PDF). mathunion.org. June 1, 2009. Archived (PDF) from the original on June 17, 2009. Retrieved February 21, 2022. ^ "Chern Medal Award". International Mathematical Union (IMU). Archived from the original on August 25, 2010. Retrieved January 23, 2022. ^ "The Leroy P Steele Prize of the AMS". School of Mathematics and Statistics, University of St Andrews, Scotland. Archived from the original on November 17, 2022. Retrieved November 17, 2022. ^ Chern, S. S.; Hirzebruch, F. (September 2000). Wolf Prize in Mathematics. doi:10.1142/4149. ISBN 978-981-02-3945-9. Archived from the original on February 21, 2022. Retrieved February 21, 2022. ^ "The Wolf Prize". Wolf Foundation. Archived from the original on January 12, 2020. Retrieved January 23, 2022. ^ a b "Hilbert's Problems: 23 and Math". Simons Foundation. May 6, 2020. Archived from the original on January 23, 2022. Retrieved January 23, 2022. ^ Feferman, Solomon (1998). "Deciding the undecidable: Wrestling with Hilbert's problems" (PDF). In the Light of Logic. Logic and Computation in Philosophy series. Oxford University Press. pp. 3–27. ISBN 978-0-19-508030-8. Retrieved November 29, 2022. ^ "The Millennium Prize Problems". Clay Mathematics Institute. Archived from the original on July 3, 2015. Retrieved January 23, 2022. ^ "Millennium Problems". Clay Mathematics Institute. Archived from the original on December 20, 2018. Retrieved January 23, 2022. Bouleau, Nicolas (1999). Philosophie des mathématiques et de la modélisation: Du chercheur à l'ingénieur. L'Harmattan. ISBN 978-2-7384-8125-2. Boyer, Carl Benjamin (1991). A History of Mathematics (2nd ed.). New York: Wiley. ISBN 978-0-471-54397-8. Cresswell, Julia (2021). Oxford Dictionary of Word Origins (3 ed.). Oxford University Press. ISBN 978-0-19-886875-0. Devlin, Keith (2018). Sets, Functions, and Logic: An Introduction to Abstract Mathematics (3 ed.). CRC Press. ISBN 978-1-4822-8602-1. Archived from the original on October 7, 2024. Retrieved October 4, 2024. Eves, Howard (1990). An Introduction to the History of Mathematics (6th ed.). Saunders. ISBN 978-0-03-029558-4. Kleiner, Israel (2007). Kleiner, Israel (ed.). A History of Abstract Algebra. Springer Science & Business Media. doi:10.1007/978-0-8176-4685-1. ISBN 978-0-8176-4684-4. LCCN 2007932362. OCLC 76935733. S2CID 117392219. Retrieved February 8, 2024. Kline, Morris (1990). Mathematical Thought from Ancient to Modern Times. New York: Oxford University Press. ISBN 978-0-19-506135-2. Monastyrsky, Michael (2001). "Some Trends in Modern Mathematics and the Fields Medal" (PDF). CMS – Notes – de la SMC. 33 (2–3). Canadian Mathematical Society. Archived (PDF) from the original on August 13, 2006. Retrieved July 28, 2006. Peirce, Benjamin (1881). Peirce, Charles Sanders (ed.). "Linear associative algebra". American Journal of Mathematics. 4 (1–4) (Corrected, expanded, and annotated revision with an 1875 paper by B. Peirce and annotations by his son, C.S. Peirce, of the 1872 lithograph ed.): 97–229. doi:10.2307/2369153. hdl:2027/hvd.32044030622997. JSTOR 2369153. Corrected, expanded, and annotated revision with an 1875 paper by B. Peirce and annotations by his son, C. S. Peirce, of the 1872 lithograph ed. Google Eprint and as an extract, D. Van Nostrand, 1882, Google Eprint. Retrieved November 17, 2020.. Peterson, Ivars (1988). The Mathematical Tourist: Snapshots of Modern Mathematics. W. H. Freeman and Company. ISBN 0-7167-1953-3. LCCN 87033078. OCLC 17202382. Popper, Karl R. (1995). "On knowledge". In Search of a Better World: Lectures and Essays from Thirty Years. New York: Routledge. Bibcode:1992sbwl.book.....P. ISBN 978-0-415-13548-1. Riehm, Carl (August 2002). "The Early History of the Fields Medal" (PDF). Notices of the AMS. 49 (7): 778–782. Archived (PDF) from the original on October 26, 2006. Retrieved October 2, 2006. Sevryuk, Mikhail B. (January 2006). "Book Reviews" (PDF). Bulletin of the American Mathematical Society. 43 (1): 101–109. doi:10.1090/S0273-0979-05-01069-4. Archived (PDF) from the original on July 23, 2006. Retrieved June 24, 2006. Whittle, Peter (1994). "Almost home". In Kelly, F.P. (ed.). Probability, statistics and optimisation: A Tribute to Peter Whittle (previously "A realised path: The Cambridge Statistical Laboratory up to 1993 (revised 2002)" ed.). Chichester: John Wiley. pp. 1–28. ISBN 978-0-471-94829-2. Archived from the original on December 19, 2013. Library resources about Mathematics Online books Resources in your library Resources in other libraries Benson, Donald C. (1999). The Moment of Proof: Mathematical Epiphanies. Oxford University Press. ISBN 978-0-19-513919-8. Davis, Philip J.; Hersh, Reuben (1999). The Mathematical Experience (Reprint ed.). Boston; New York: Mariner Books. ISBN 978-0-395-92968-1. Available online (registration required). Courant, Richard; Robbins, Herbert (1996). What Is Mathematics?: An Elementary Approach to Ideas and Methods (2nd ed.). New York: Oxford University Press. ISBN 978-0-19-510519-3. Gullberg, Jan (1997). Mathematics: From the Birth of Numbers. W.W. Norton & Company. ISBN 978-0-393-04002-9. Hazewinkel, Michiel, ed. (2000). Encyclopaedia of Mathematics. Kluwer Academic Publishers. – A translated and expanded version of a Soviet mathematics encyclopedia, in ten volumes. Also in paperback and on CD-ROM, and online. Archived December 20, 2012, at archive.today. Hodgkin, Luke Howard (2005). A History of Mathematics: From Mesopotamia to Modernity. Oxford University Press. ISBN 978-0-19-152383-0. Jourdain, Philip E. B. (2003). "The Nature of Mathematics". In James R. Newman (ed.). The World of Mathematics. Dover Publications. ISBN 978-0-486-43268-7. Pappas, Theoni (1986). The Joy Of Mathematics. San Carlos, California: Wide World Publishing. ISBN 978-0-933174-65-8. Waltershausen, Wolfgang Sartorius von (1965) [1856]. Gauss zum Gedächtniss. Sändig Reprint Verlag H. R. Wohlwend. ISBN 978-3-253-01702-5. Portals: Mathematics Arithmetic History of science ScienceMathematics at Wikipedia's sister projects:Definitions from WiktionaryMedia from CommonsNews from WikinewsQuotations from WikiquoteTexts from WikisourceTextbooks from WikibooksResources from WikiversityData from Wikidata Retrieved from "